

REMARKS

A. Status of the Claims / Amendments to the Claims

In the Office Action of May 15, 2008, the status of the claims was as follows:

Claims 69-73 were objected-to.

Claims 54, 55 and 61-68 were rejected under 35 U.S.C. §112.

Claims 48-73 were rejected on various prior art grounds under 35 U.S.C. §§102 and 103.

Claims 61 and 64-68 were provisionally rejected based on "obviousness-type" double patenting.

In this Amendment and Response, all of the previously pending Claims 48-73 have been canceled. New Claims 74-90 have been added. No new matter has been added. New Claims 74-90 are directed to particular preferred embodiments of this invention as described in the Specification and as exemplified by Example 1 of the Examples.

More particularly, new independent claims 74 and 88 are directed to electroluminescent devices wherein at least one layer comprising a first electroluminescent metal complex or first organometallic complex alternates with at least one layer comprising a second electroluminescent metal complex or second organometallic complex, and also wherein the band gap of the second metal complex or second organometallic complex is larger than that of the first metal complex or first organometallic complex. Example 1 at pages 22-23 of the Specification provides examples of electroluminescent devices in accordance with new Claims 74-90. (Examples 2 and 3 are directed to other embodiments of the invention.)

New Claims 75, 76, 84, 88 and 89 are supported by Example 1 and also by the description at page 2, lines 17-25 of the Specification. New claim 77 is supported by Example 1 and by Figs. 15 and 16. New Claims 78 and 79 are supported by the description at page 3, lines 22-25 of the Specification. New Claims 80 and 83 are supported by the description at page 5, lines 16-19 of the Specification. New Claims 81, 82 and 90 are supported by the description at page 3, lines 27-32 of the Specification. New Claim 86 is supported by the description at page 22, lines 1-6 of the Specification.

Because all of the previously pending Claims 48-73 have been canceled, the objections and rejections of the Office Action are now moot. In new Claims 74-90, Applicants have taken care to avoid the claim constructions that were earlier objected-to or rejected on Sec. 112 grounds.

For the reasons discussed in more detail below, Applicants also respectfully submit that new Claims 74-90 clearly distinguish over the prior art references and also over the claims of the commonly-assigned 10/540,372 U.S. patent application. Accordingly, Applicants submit that the prior art and double patenting rejections of the Office Action are not applicable to new Claims 74-90.

B. Sec. 102(b) Rejection – Hong et al.

In paragraphs 9-12 of the Office Action, Claims 48-53, 60 and 73 were rejected under 35 U.S.C. §102(b) as being anticipated by the Hong et al. literature reference. Claims 48-53, 60 and 73 have been canceled; and, Applicants respectfully submit that new Claims 74-90 clearly distinguish over Hong et al.

Hong et al. criticizes known electron transport materials, such as aluminum quinolate and PBD, because of the problem of apparent luminescence, which means that the light emitted may not have just the spectrum of the electroluminescent layer, and also because of alleged stability problems. The disclosed solution in Hong et al. is to use a rare earth chelate as an electron transport layer in a structure having only two layers interposed between the anode and the cathode of this device (see Fig. 1 of Hong). A glass substrate with an ITO layer is employed as the anode. A first layer is deposited on the anode which has combined hole transport and electroluminescent properties. That first layer is of a thickness of 100 nm, and it comprises PVK together with electroluminescent Eu(DBM)₃phen or Eu(DBM)₃bath. The next layer of the Hong device is an electron transport layer of a thickness of 30 nm and comprising Y, La or Gd acetylacetae phenanthroline (RE(AcA)₃phen). The Hong device is completed with an aluminum cathode. Hong concludes that, by inserting a RE(AcA)₃phen film between the cathode and the emitting layer, the emission intensity of the resulting device was considerably increased compared with devices without such a layer, i.e., that rare earth chelates have good electron transport properties.

Hong differs from the devices claimed in new independent Claims 74 and 88, however, because there is no disclosure of a separate layer of a hole transport material, and there is also no disclosure of a separate layer of electron transport material not containing a rare earth element. The electron transport materials used in the present invention are disclosed at page 21, lines 4-14 of the application, and aluminum quinolate is employed in Example 1. By contrast, Hong teaches away from the use of a layer of an electron transport material that does not contain a rare earth chelate.

Furthermore, Hong does not disclose the claimed structure wherein at least one layer comprising a first electroluminescent metal complex or first organometallic complex alternates with at least one layer comprising a second electroluminescent metal complex or second organometallic complex, and also wherein the band gap of the second electroluminescent metal complex or second organometallic complex is larger than that of the first electroluminescent metal complex or first organometallic complex. Hong certainly fails to recognize that such an alternating layer structure would be advantageous in an electroluminescent device where there is a separate electron transport layer. Such advantages are clearly demonstrated in Example 1 of this application.

For example, Structure 2 in Table 1 at page 22 illustrates the effect of increasing the number of the disclosed alternating layers and of reducing the thickness of the layer of material of higher band gap to 10 nm. The result is to unexpectedly increase the light output of the device from 2.4 to 15.4 Cd/m² (more than a 6-fold increase!) and to also unexpectedly almost double the efficiency from 1.13 to 2.02 Cd/A. These surprisingly improved performance characteristics are nowhere disclosed or suggested by Hong. If the overall layer thicknesses in Structure 1 and Structure 2 of Example 1 of this application are compared, the value for Structure 1 is 119.1nm while that for Structure 2 is 118nm. Thus, the current paths through the OLED materials for the two structures are substantially identical in length, which highlights how surprising it is that Structure 2 demonstrates such superior performance in light output and efficiency compared with Structure 1.

With reference to new Claims 74, 75 and 88, Hong nowhere discloses or suggests structures in which layers of a first electroluminescent metal complex or first organometallic complex are separated by a layer or layers of a second electroluminescent metal complex or

second organometallic complex, wherein the band gap of the second electroluminescent metal complex or second organometallic complex is larger than that of the first electroluminescent metal complex or first organometallic complex.

For all of these reasons, Applicants respectfully submit that new Claims 74-90 clearly distinguish over the Hong et al. reference.

C. Sec. 103(a) Rejection – Hong et al. / Kathirgamanathan '037

In paragraphs 13-17 of the Office Action, Claim 54 was rejected under 35 U.S.C. §103(a) as being unpatentable over the Hong et al. literature reference in view of international patent publication No. WO 9858037 (Kathirgamanathan '037). Claim 54 has been canceled; and, Applicants respectfully submit that new Claims 74-90 clearly distinguish over Hong and Kathirgamanathan '037, whether these references are taken individually or in combination.

The deficiencies of the Hong reference relative to new Claims 74-90 have been thoroughly discussed in part (B) above. Kathirgamanathan '037 fails to correct those deficiencies.

Thus, although Kathirgamanathan '037 discloses the specific complex $\text{Eu}(\text{DBM})_3\text{OPNP}$, it does not disclose or suggest a structure wherein there are alternating layers of electroluminescent materials having different band gaps, as claimed. Therefore, Kathirgamanathan '037 adds nothing relevant to the disclosure of Hong.

D. Sec. 103(a) Rejection – Hong et al. / Liang et al.

In paragraphs 18-21 of the Office Action, Claim 55 was rejected under 35 U.S.C. §103(a) as being unpatentable over the Hong et al. literature reference in view of the Liang et al. literature reference. Claim 55 has been canceled; and, Applicants respectfully submit that new Claims 74-90 clearly distinguish over Hong and Liang, whether these references are taken individually or in combination.

The deficiencies of the Hong reference relative to new Claims 74-90 have been thoroughly discussed in part (B) above. Liang fails to correct those deficiencies.

More particularly, the disclosure of Liang is similar to that of Hong since it is also concerned with two-layer OLED devices in which $\text{Gd}(\text{DBM})_3$ bath is used as an electron transporter. Because Liang uses a rare earth-containing electron transport material, Liang teaches away from the presently pending claims and adds nothing relevant to the disclosure of Hong.

E. Sec. 103(a) Rejection – Hong et al. / Yang '873

In paragraphs 22-25 of the Office Action, Claim 56, 57 and 69-70 were rejected under 35 U.S.C. §103(a) as being unpatentable over the Hong et al. literature reference in view of U.S. Pat. No. 5,723,873 (Yang '873). Claims 56, 57 and 69-70 have been canceled; and, Applicants respectfully submit that new Claims 74-90 clearly distinguish over Hong and Yang '873, whether these references are taken individually or in combination.

The deficiencies of the Hong reference relative to new Claims 74-90 have been thoroughly discussed in part (B) above. Yang '873 fails to correct those deficiencies.

Yang '873 is cited on the ground that it describes a hole transporting (buffer) layer of polyaniline between an ITP electrode and a light-emitting layer, which, according to the Examiner, could be used in the device of Hong. But, such a structural re-configuration is directly contrary to the teachings of Hong that a single layer should be used combining the functions of electroluminescence and hole transport. It is never "obvious" to make a structural substitution in a reference that is directly contrary to the teachings of that reference and likely to render the resulting structure ineffective for its intended purpose. Thus, Yang '873 adds nothing relevant to the teaching of Hong.

F. Sec. 103(a) Rejection – Hong et al. / Endo et al.

In paragraphs 26-29 of the Office Action, Claims 58, 59, 71 and 72 were rejected under 35 U.S.C. §103(a) as being unpatentable over the Hong et al. literature reference in view of the Endo et al. literature reference. Claims 58, 59, 71 and 72 have been canceled; and, Applicants respectfully submit that new Claims 74-90 clearly distinguish over Hong and Endo, whether these references are taken individually or in combination.

The deficiencies of the Hong reference relative to new Claims 74-90 have been thoroughly discussed in part (B) above. Endo fails to correct those deficiencies.

More particularly, the Examiner relies on Hong as describing a device in which the light-emitting material is a Europium complex and in which a gadolinium complex is used as an electron transport material. The Examiner then argues that Hong is silent about the use of an electron transmitting material between the electroluminescent compound layer and the second electrode. But, this position is not an accurate reading of Hong. In Hong, the electron transport material is the gadolinium complex, and that material is considered essential to the

intended operation of the Hong device. Thus, the substitution of an electron transmitting layer that does not contain a rare earth chelate, based on the teachings of Endo, is contrary to the teachings and requirements of Hong. As previously stated, it is never “obvious” to make a structural substitution in a reference that is directly contrary to the teachings of that reference and likely to render the resulting structure ineffective for its intended purpose. Thus, the Endo et al. literature reference adds nothing relevant to the disclosure of Hong.

G. Sec. 103(a) Rejection – D’Andrade ‘814 / Adachi et al.

In paragraphs 30-34 of the Office Action, Claims 61-67 were rejected under 35 U.S.C. §103(a) as being unpatentable over international patent publication No. WO 02091814 (D’Andrade ‘814) in view of the Adachi et al. literature reference. Claims 61-67 have been canceled; and, Applicants respectfully submit that new Claims 74-90 clearly distinguish over D’Andrade ‘814 and Adachi, whether these references are taken individually or in combination.

Because the focus of new Claims 74-90 is so completely different from that of previous Claims 61-67 and from the subject matter of the D’Andrade ‘814 and Adachi et al. references, Applicants respectfully submit that no additional comments are needed about how the new claims distinguish over these references.

H. Sec. 103(a) Rejection – D’Andrade ‘814 / Adachi et al. / Kathirgamanathan ‘037

In paragraphs 35-38 of the Office Action, Claim 68 was rejected under 35 U.S.C. §103(a) as being unpatentable over international patent publication No. WO 02091814 (D’Andrade ‘814) in view of the Adachi et al. literature reference and further in view of

international patent publication No. WO 9858037 (Kathirgamanathan '037). Claim 68 has been canceled; and, Applicants respectfully submit that new Claims 74-90 clearly distinguish over D'Andrade '814, Adachi and Kathirgamanathan '037, whether these references are taken individually or in combination.

Because the focus of new Claims 74-90 is so completely different from that of previous Claim 68 and from the subject matter of the D'Andrade '814, Adachi et al. and Kathirgamanathan '037 references, Applicants respectfully submit that no additional comments are needed about how the new claims distinguish over these references.

I. Provisional Obviousness-Type Double Patenting Rejection – Kathirgamanathan '732

In paragraphs 39-40 of the Office Action, Claims 61 and 64-68 were provisionally rejected based on obviousness-type double patenting over Claims 36 and 38-41 of copending U.S. Pat. Appln. Ser. No. 10/540,732 (Kathirgamanathan '732). Claims 61 and 64-68 have been canceled; and, Applicants respectfully submit that new Claims 74-90 clearly distinguish over the claims pending in the Kathirgamanathan '732 application.

Because the focus of new Claims 74-90 is so completely different from that of previous Claims 61 and 64-68 and from the subject matter claimed in the Kathirgamanathan '732 application, Applicants respectfully submit that no additional comments are needed about how the new claims distinguish over the claims of this copending application.

Application Serial No. 10/540,733
Amendment and Response

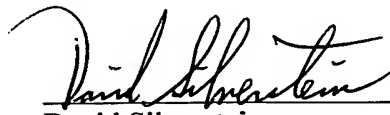
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Attorney Docket No.: LUC-014

SUMMARY AND CONCLUSIONS

For all of the foregoing reasons, Claims 74-90 are believed to be in condition for allowance and an early notice thereof is earnestly requested.

Respectfully submitted,

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